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# PROVISIONAL INTELLIGENCE REPORT

# THE ANTIMONY INDUSTRY IN THE SOVIET BLOC

CIA/RR PR-81
6 November 1954



CENTRAL INTELLIGENCE AGENCY

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CIA/RR PR-81

(ORR Project 24.183)

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# THE ANTIMONY INDUSTRY IN THE SOVIET BLOC*

## Summary

Antimony, a nonferrous metal, has diverse uses which have made it a vital commodity in both the civilian and military sectors of the economy of the Soviet Bloc. Antimony alloys and compounds are important components of bearings, storage batteries, small arms ammunition, solders, and a host of other industrial products.

Total production of antimony** in the Soviet Bloc in 1953 was about 18,450 metric tons,*** approximately double the production in 1948. Communist China was the largest producer, with about 11,000 tons, more than 3 times its 1948 production. The USSR produced about 5,000 tons and the European Satellites about 2,450 tons. The Soviet production, although it was two and one-half times the 1948 production, was equal to only 60 percent of the current normal requirements in the USSR, and the Satellite production was also somewhat short of demand. About one-third of the total combined requirements of the USSR and the European Satellites was supplied from Chinese Communist production.

Reserves of antimony ore in the Soviet Bloc are adequate for any foreseeable demand. Communist China alone has known reserves of nearly 4 million tons -- enough for 360 years of production at 1953 levels -- and the USSR has reserves which would last about 100 years. Reserves in the European Satellites are smaller, particularly in East Germany.

Only minor quantities of antimony are imported by the Soviet Bloc from non-Bloc countries -- about 400 tons in 1953 -- and little is exported to non-Bloc countries. The pattern of trade for the Soviet Bloc, then, is largely one of intra-Bloc imports and exports.

* The estimates and conclusions contained in this report represent the best judgment of the responsible analyst as of 15 August 1954.

** Unless otherwise specified, antimony refers to primary antimony and excludes reclaimed or reprocessed antimony.

*** Throughout this report, tonnages are given in metric tons.



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Communist China exports to the USSR almost all of its production, and Czechoslovakia exports to the other European Satellites. The USSR is both an importer from Communist China and an exporter to the European Satellites.

Total supply of antimony in the Soviet Bloc in 1953 was about 18,850 tons. The total supply in the USSR was 15,000 tons; in the European Satellites, 3,150 tons; and in Communist China, 700 tons.

Total consumption of antimony in the Soviet Bloc in 1953 is estimated at 11,500 tons. Of this total the USSR consumed about 8,350 tons and the European Satellites about 3,150 tons. The amount consumed in Communist China was negligible.

The quantitative antimony use pattern for the USSR is indicative of the consumption pattern for the Soviet Bloc. Of the total 8,350-ton consumption in the USSR in 1953, about 2,180 tons were used in the manufacture of bearings, about 3,500 tons in storage batteries, about 1,000 tons in small arms ammunition, about 930 tons for miscellaneous products, and about 735 tons in antimony compounds (nonmetallic).

The total supply of antimony in the Soviet Bloc in 1953 exceeded total consumption by about 7,350 tons. A study of the supply-consumption relationship for the years from 1948 through 1953 indicates that the total surplus for the period amounts to about 21,000 tons. Assuming that 1,000 tons of this accumulated surplus is in industrial stocks, the strategic stockpile of antimony in the Soviet Bloc is about 20,000 tons. When added to annual production at current levels, this stockpile constitutes more than a 5-year supply for the normal peacetime requirements of the USSR.

Although the European Satellites as a group probably cannot increase production substantially, there is evidence to indicate that Communist China could double production and that the USSR could probably make small increases in production. The Soviet Bloc as a whole, then, has a high capability for increased production of antimony, and the industry is not significantly vulnerable.

If the Bloc were deprived of Chinese Communist resources, however, the situation would be quite different. Production facilities in the USSR are concentrated in two plants. In the event of war,

disruption of production would confront the economy with antimony supply troubles within 2 or 3 years. Increased demands would probably deplete the stockpile, and shortages of antimony would affect the Soviet military machine vitally. Conservation of antimony in any of its present uses in the USSR would increase the shortages of other critical metals, notably lead and tin.

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## I. Introduction.

### A. Importance.

In relative terms the antimony industry in the Soviet Bloc is small. Measured in 1953 US dollars and prices, the value of its output is about 15 million dollars annually, about 2 percent of the total nonferrous mining industry in the Bloc. The industry draws on the Bloc's labor force for only about 30,000 workers.

It is misleading, however, to measure the importance of antimony in these terms. The USSR is concerned -- as is any industrial nation -- with the maintenance of an adequate supply of the metal. The reasons for this concern become evident on examination of the wide range of uses of antimony alloys now employed in the USSR. The actual specifications used by Soviet procurement agents, and the uses to which the varied alloys are put in the USSR, 1/* are presented in Table 1.**

In addition to direct military uses in aircraft engines, tanks, and naval vessels of all types, antimony alloy bearings perform thousands of other important jobs. In rolling mills, machine tools, turbines, stationary steam engines, electric motors, generators, compressors, locomotives, railway wagons, turbocompressors, diesel engines, a wide variety of internal combustion engines, transmissions, mining machinery, armature bearings, and in many other machines and types of power equipment, antimony alloy

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* Footnote references in arabic numerals are to sources listed in Appendix D.

** Table 1 follows on p. 4. For additional uses see Tables 18 and 19 in Appendix A.

Table 1

Antimony Alloy Specifications in the USSR a/*

| Soviet Designation | Antimony Content (Percent) | Use |
|---|---|---|
| BRO 10 | 0.5 | Tin bronze; casting bronze; substitute bronze. |
| BRO 19 | 0.3 | High tin bronze. |
| BRO No. 9 | 0.8 (minimum) | Special acid-resistant bronze. |
| BRO No. 11 | 0.2 (minimum) | Special acid-resistant bronze. |
| BRONS 11-4-3 | 0.4 | Leaded bronze; parts working under conditions of high temperature: rolling mill bearings, valve guides, aircraft engine parts, and the like. |
| BROS 1-22 | 0.4 | Copper-lead bearing alloy. |
| BROS 5-25 | 0.5 | High leaded tin bronzes; bearings and bushings, especially for heavy-load and high-temperature conditions. |
| BROSH 10-2-3 | 0.3 | Leaded tin bronze. |
| BROA | 0.5 | Phosphor bronze; sprocket and gear wheels. |
| BROTs 4-3 | 0.02 | Tin bronze; sheet, strip, bars, wire, springs, scrapers for paper-making industry. |
| BROTs | 0.05 | Gun metal; castings. |
| BROTs 3-12-5 | 0.4 | Leaded red brass; cast freshwater and salt-water steam fittings. |
| BROTs S 3.5-5.5 | 0.4 | Leaded red brass; tractor parts. |
| BROTs | 0.5 | High lead red brass; antifriction metal. |
| AA 67-2.5 | 0.1 | Aluminum brass, cast; general and marine engineering parts. |
| AASMR | 2.0 to 4.0 | Al-Fe-Mn bronze made from reprocessed scrap. |

* Footnote for Table 1 follows on p. 7.

Table 1

Antimony Alloy Specifications in the USSR
(Continued)

| Soviet Designation | Antimony Content (Percent) | Use |
|---|---|---|
| LASMTs 70-6-3-1 | 0.1 | Al-Fe-Mn bronze; cast nuts, heavy worm gears. |
| LMTsUS 55-4-1 | 0.1 | Mn-Fe brass; propellers and propeller blades; corrosion resistant ship fittings. |
| LMTsNS 52-2-2-1 | 0.1 | Mn-Ni-Fe brass; large castings for ship construction, spindles, valve parts, and the like, of marine engines. |
| LOS 65-1-2 | 0.2 | High brass; water piping, heating and pipe fittings. |
| MM | 0.5 | Cu-Mn hardener alloy with 900° C melting point. |
| B 6 | 14.0 to 16.0 | Babbitt; lining bearings of petrol engines, machine tools, ventilation fans, ball mills, electric fans below 250 kw, and the like. |
| B 10 | 15.0 | Babbitt; lining bearings. |
| B 16 | 15.0 to 17.0 | Babbitt; lining bearings of turbines, marine and stationary steam engines over 1200 hp, portable steam engines, electric motors and locomotives of 250 to 750 kw, generators, compressors, and the like. |
| B 90 | 7.0 to 8.5 | Babbitt; lining bearings of aircraft engines. |
| BK | 0.25 | Babbitt; lining bearings of aircraft engines. |

Table 1

Antimony Alloy Specifications in the USSR
(Continued)

| Soviet Designation | Antimony Content (Percent) | Use |
|---|---|---|
| B 83 | 10.0 to 12.0 | Babbitt; lining bearings of high-power aircraft engines, steam turbines, turbocompressors, pumps, diesels, marine steam engines, electric motors, generators, and the like. |
| BM | 13.0 to 15.0 | Babbitt (substitute for B 83); lining bushings of internal combustion engines, stationary and mobile steam turbines, and the like. |
| BM 6 | 14.0 to 15.0 | B - 6 with an admixture of Ni; lining machine tool bearings. |
| BS | 16.0 to 18.0 | Babbitt; lining bearings of railway wagons, wide and narrow gauge. |
| BT | 14.0 to 16.0 | Babbitt; lining main and big-end bearings of automobiles and tractors. |
| LN | 11.0 to 12.0 | Type metal for printing presses. |
| MT 2 | 14.0 to 16.0 | Type metal. |
| S 2 | 0.01 | Lining acid-proof apparatus, and in accumulator industry. |
| MR 4-4 | 0.15 | Cast and wrought aluminum alloys. |
| MTs - 42 | 0.1 | Cu-Zn hard solder; brasses and bronzes. |
| LOS - 18 | 2.0 to 2.5 | Soft solder for tinplate, iron, brass, copper. |

Table 1

Antimony Alloy Specifications in the USSR
(Continued)

| Soviet Designation | Antimony Content (Percent) | Use |
|---|---|---|
| LOS - 30 | 1.5 to 2.5 | Soft solder for tinplate, aircraft radiators, instruments, radio apparatus. |
| SS - U | 0.3 to 3.0 | Antimony solder. |

a. 2/

bearings are used. The vital characteristic of furnishing a hard phase embedded in a soft matrix, thus permitting the bearing to adjust itself to the pressure and strain of the rotating shaft without excessive friction, has made the antimony alloy bearing an indispensable component of Soviet industry.

Storage batteries represent another important use of antimony. The battery plates of the conventional storage battery used in tanks, trucks, military and civilian vehicles of many kinds, and in the submarine fleet, contain from 5 percent to 12 percent antimony, which greatly increases their life and efficiency. In addition to the "starting" batteries are the stationary batteries for communications and emergency light and power facilities.

The Soviet specifications also indicate the important use of antimony in solder and type metal. Though relatively low tonnages of antimony are consumed in solder, this use is a vital one. The intricate wiring in radio, electronics, and telecommunications is assembled with solder. Type metal, essential to mass written communication, is also a moderate though steady user of antimony.

Many other uses of antimony are not so easily categorized. Castings for ship construction and marine engineering parts, sprockets, gear wheels, heavy worm gears, valve guides, propeller blades,

chemical plant equipment, and foundry facings use small but important amounts of antimony in the USSR. Cable sheathing and piping are less strategic, general utility uses.

The remaining important use of antimony in the USSR is in the antimonial lead bullet core filler in almost all small arms ammunition. 3/ Except where heavy armor piercing is required, a standard 90 percent lead to 10 percent antimony filler is used.

The uses indicated in Table 1 include only the metallic uses of antimony. In addition to these metallic forms, there are many important antimony compounds which together consume moderate tonnages. The most important of the compounds are antimony sulfide, used in making ammunition primers, glass, and red rubber products; sodium antimonate, used in making porcelains and enamels for metal ware; antimony tetroxide, used in refractory frits, ceramic enamels, and paint pigments; antimony trioxide, used as the tetroxide above and also in combination with chlorinated rubber or paraffin to make fabrics (such as canvas) flameproof and fire-resistant; and antimony oxide, trichloride, and fluoride, used in making glass and in electroplating.

B. Description and Substitutes.

Antimony is a bluish-white metal with a crystalline, scale-like structure. Its symbol is Sb. Because it is neither malleable nor ductile, it is used only in alloys or in its chemical forms. It imparts hardness and a smooth surface to soft metal alloys, making it a key metal in the manufacture of the very large "white metal" bearing family. Alloys containing antimony expand on cooling; this is the particular property that makes it essential in type metal.

In considering possible substitutes for antimony, it must be remembered that antimony is a mature metal; its present position among the metals is based on long years of industrial research, on cost considerations, and on relative availability compared with the other metals. Much substitution has already taken place, and consumption patterns are well established in the metallic uses. In the bearing category, for example, it is unlikely that further significant substitution will take place. A bearing is made, in general, to perform a particular task. Hardness, smoothness, strength, heat resistance, and corrosion resistance cannot be

maximized simultaneously. A bearing thus must represent a compromise of these attributes, the direction of the compromise being determined by the job to be done. This is the deciding factor in the composition of the bearing alloy. The features desired, in turn, determine the amount of antimony (and other metals) to be used.

In the battery category, significant substitution is not likely as long as the conventional lead-antimony storage battery continues in use. Although the cadmium-nickel battery is in limited use in the USSR, 4/ cost differentials and availabilities of the metals involved indicate continued dependence on the conventional storage battery.

Antimony has been used to make type metal for 500 years, and although plastics are considered to have some future in printing, significant substitution in this use appears unlikely. Type metal is not thrown away, but is melted and reused, "consumption" coming only through melting losses which are replaced. This obvious cost advantage, in addition to the technical ones mentioned, is an added reason why substitution in this use will be slow. The future use of antimony in solder also appears to be secure; extensive research in this important industrial material has resulted in great stability in the mixtures now used.

Patterns of consumption are much less stable in the nonmetallic uses. There is much competition between the numerous metallic compounds in such uses as paint pigments and ceramic enamels. Because these uses are much newer than the metallic uses, changes in consumption can be expected. Some of these changes may actually increase the use of antimony. In plating, for example, antimony may replace other plating metals, such as chrome, where corrosion resistance is considered more important than resistance to scratching. 5/

## II. Supply.

### A. Organization of the Industry.

In the USSR, the production of antimony is under the direction of the Ministry of Nonferrous Metallurgy. The Ministry of Ferrous Metallurgy, USSR, and the Ministry of Nonferrous Metallurgy, USSR, were formed as separate ministries by decree of the Presidium of the Supreme Soviet, USSR, on 8 February 1954. 6/ P.F. Lomako

was appointed at that time as Minister of Nonferrous Metallurgy, USSR. 7/ Prior to this time, both ferrous and nonferrous metals were under the Ministry of Metallurgical Industry, USSR. The two important antimony combines, the intermediate subordination of which is not known, are the Kadamshay Mining and Metallurgical Combine imeni Frunze, 8/ and the Khaydarkan Mining and Metallurgical Combine. 9/

In China, production of antimony is under the control of the Ministry of Heavy Industries. 10/ Perhaps a more significant feature of mining control in China is that many of the important mines are under direct Soviet management. 11/

Antimony production in East Germany is under the general regulation and control of the Ministry for Mining and Smelting. Under this Ministry is a Main Administration for Nonferrous Metals Industries with one subdivision for mining and another for metallurgy. 12/ The head of the Ministry is a member of the Council of Ministers of East Germany. 13/

In Czechoslovakia, production of antimony is under two Main Administrations at different stages. Mining operations are under the Main Administration of Nonferrous Metal Mines. The State Enterprise Stredoceske Rudne doly operates the Pribram mines, and the State Enterprise Rudne Bane is in charge of the Chuchma mines. The smelting of antimony at both Vajskova' and Pribram is under the direction of the Main Administration for the Working of Nonferrous Metals. 14/

B. Facilities.

1. USSR.

The mine production of antimony in the USSR comes from seven locations and about a dozen "mines."* With the exception of Turgay, in the western part of Kazakh SSR (Economic Region** Xa), and Razdolinsk, close to the border between East and West Siberia at Krasnoyarsk (Economic Region XI), the Soviet antimony industry is located in a relatively small area extending from north-central Kirghiz SSR through northern Tadzhik SSR to eastern Uzbek SSR (all

* More properly "mine locations," some with several mines.
** The term region in this report refers to the economic regions defined and numbered in CIA Map 12048, 9-51 (First Revision 7-52), USSR: Economic Regions.

in Economic Region Xb), a distance of only 500 miles. The ores from Soviet mines go to only two smelter locations -- the larger one at Kadamshay, operated by the Frunze Combine in Kirghiz SSR 15/; the other at Turgai. 16/ The pattern of mine and smelter location is indicated in Table 2.*

Kadamshay is the largest, most important antimony operation in the USSR. 17/ The operation includes several large mines which produce around one-third of the total ores milled and smelted by the smelter. The remainder is custom smelted,** with about half of the ores coming from the large mining operation at Khaydarken, about 300 miles away. 18/ The ore reserves at these mines are sufficient for at least 100 years at the present rate of operation. 19/ A short distance north of the Khaydarken mines is a small mining operation at Kassan-say which sends its ore, about 5,000 tons annually, to the Kadamshay smelter. 20/ Two small mines are located at Chavdar and Cherek-sai in southeastern Uzbek SSR in an isolated mountain area. Mining methods are primitive and the output small. The ore from these mines also goes to the Kadamshay smelter, 21/ a distance of about 500 miles. There are two well-known deposits of antimony at Chauvay, which is near the Kadamshay smelter. Reserves are said to be small, around 3,000 tons of antimony content, 22/ but are sufficient to support the mining of 1,000 tons to 1,500 tons of ore per year for 10 years. At Takfan, in Tadzhik SSR, is another deposit which appears to be of considerable importance in Soviet plans. 23/ It was reported in early 1952 that a large antimony "enterprise" was planned for this location. There is no further evidence of activity at Takfan, but it is reasonable to assume that the deposits are being mined.

About 1,200 miles away from this group of mines is a large mining operation at Razdolinsk. It is reported that the Soviet smelter at Turgay does not smelt ores other than its own. 24/ It is assumed, therefore, that the sizeable quantities of antimony at Razdolinsk, 25/ which are concentrated there to reduce the bulk of the shipments, must make the 1,200-mile trip to Kadamshay. The size of the mining operation and the distance from Kadamshai indicate a real need for a smelter at this location. On the basis of

* Table 2 follows on p. 12.

** A custom smelter handles ores from other mines as well as local ores.

Table 2

Antimony Establishments in the USSR

| Establishment | Location | Facilities | Remarks |
|---|---|---|---|
| Kadamshay (Frunze) | 40°08' N - 71°48' E Kirghiz SSR | Mines, mills, smelter, and power station. a/* | Largest, most complete antimony operation in USSR. Besides milling and smelting ore from its own mines, it mills and smelts ores from other mines. Mercury also is produced here. b/ |
| Turgay (Turgaistroi) | 49°40' N - 63°30' E Kazakh SSR | Mines, mills, smelter, and power station. a/ c/ | A complete antimony operation, but appears to mill and smelt little if any ores other than its own. a/ c/ Second largest smelter in USSR. Mining is both surface and underground. c/ |
| Razdolinsk (Razdol'noye) | 58°10' N - 94°10' E Krasnoyarsk, E. Siberia | Mine, mobile ore-dressing installation (1939), fixed installations planned (1942). d/ | Smaller reserves than Kadamshai. Richest seam has 16,000 tons Sb. d/ |
| Khaydarken | 39°58' N - 71°20' E | Mines | A large deposit and a large mining operation with reserves of 112,000 tons in the Eastern Slope, 72,400 tons in the Western Slope, totaling 184,400 tons e/; estimated also at 100,000 tons to 198,000 tons. d/ |
| Kassan-say | 41°15' N - 71°32' E Kazakh SSR | Mine | A small mine with annual production probably under 5,000 tons of ore. f/ |
| Chavdar and Cherek-say | 40°08' N - 67°02' E Uzbek SSR | Mines; ore goes to Kadamshay. g/ | Mining methods are said to be primitive, in an inaccessible mountain area. Small production. g/ |

* Footnotes for Table 2 follow on p. 13.

Table 2

Antimony Establishments in the USSR
(Continued)

| Establishment | Location | Facilities | Remarks |
|---|---|---|---|
| Chauvay | 40°08' N - 72°08' E Kirghiz SSR | Deposit. h/ | Reserves said to be small, around 3,000 tons of antimony. h/ |
| Takfan | 39°15' N - 68°40' E Tadzhik SSR | Deposit. h/ | Large antimony enterprise planned. h/ |
| Leninski | 48°30' N - 135°06' E Khabarovsk Krai | Deposit. d/ | Reserves estimated at 8,120 tons. Location is near the Talama River. d/ |
| Margutsor | 39°29' N - 67°37' E Tadzhik SSR (Penchikent region) | Deposit. d/ | Good ore but unfavorable transportation. Probably not mined. d/ |

a. 26/
b. 27/
c. 28/
d. 29/
e. 30/
f. 31/
g. 32/
h. 33/

this information, the sources of ores for the Kadamshay smelter operation are estimated in Table 3.

Table 3

Sources of Ores for the Kadamshay Smelter in the USSR
1953

Metric Tons

| Mine | Estimate of Ore Sent to Kadamshay | Antimony Metal Equivalent a/ |
|---|---|---|
| Kadamshay | 56,000 | 1,000 |
| Khaydarken | 84,000 | 1,500 |
| Razdolinsk | 28,000 | 500 |
| Kassan-say, Chavdar, Cherek-say, Chauvay, Takfan | 28,000 | 500 |
| Total | 196,000 | 3,500 |

a. Based on 56 tons of ore for 1 ton of metal. See input methodology, Appendix B.

The other Soviet antimony smelter, at Turgay, is part of a complete operation, with its own mines, mills, and a power station. As indicated above, Turgay does not smelt ore from mines other than its own. Descriptions of the facilities in use indicate an output of about 1,500 tons of metallic antimony in 1953. 34/ Total Soviet smelter production is summarized in Table 10.*

2. Czechoslovakia.

Mine production of antimony in Czechoslovakia comes from 2 mines and smelter production from 2 smelters. These operations are outlined in Table 4.**

* P. 24, below.
** Table 4 follows on p. 15.

Table 4

Antimony Establishments in Czechoslovakia

| Establishment | Location | Facilities | Remarks |
|---|---|---|---|
| Vajskova' | 48°44' N - 19°09' E Banska Bystrica Slovakia | Mine and smelter. a/ b/ c/ | The most modern, perhaps the largest plant of its kind in Europe. a/ b/ c/ |
| Chuchma | 48°42' N - 20°35' E Slovakia | Large mine, major deposit. d/ | The largest mining operation in Czechoslovakia. d/ |
| Pribram Lead-Zinc-Silver Mine | 49°42' N - 14°01' E Slovakia | Large mine, primarily lead-zinc-silver ore, and large smelter. d/ | Antimony is mined as a byproduct, but this mine is the second largest source. It handles only its own ores. d/ e/ |
| Dubrava | 48°35' N - 19°22' E Slovakia | Deposit. f/ | It is possible that small tonnages have been mined since 1948. f/ |
| Pezinok | 48°17' N - 17°16' E Slovakia | Deposit. f/ | Mining began between 1949 and 1952. f/ g/ |

a. 35/
b. 36/
c. 37/
d. 38/
e. 39/
f. 40/
g. 41/

The largest mining operation and the major deposit is at Chuchma, in central Slovakia.42/ The ores from this mine all go to the Vajskova' smelter at Banska Bystrica, a short distance away.

The lead-zinc-silver mine at Pribram in central Bohemia is the second largest producer in Czechoslovakia. 43/ In this operation, antimony is mined from the Pribram lead-zinc-silver ores. Pribram smelts its ores close to the mine site and, in the case of antimony, turns out both metallic antimony and antimony compounds. The Pribram smelter does not handle ore from other mines. 44/ Production of primary antimony in 1953 is estimated as 700 metric tons

The other major mining operation is at Banska Bystrica, where modern equipment and methods are used. All its ores are smelted in the Vajskova' smelter. 45/

In addition to these 3 major mining operations, there are 2 additional deposits believed to be mined at Dubravy and at Pezinok, both in central Slovakia. 46/ The exact date when mining operations began at Pezinok is not known but it was some time between 1949 and 1952. 47/ The ores from these two operations go to Vajskova'. A brief summary of the mine-smelter pattern in central Slovakia, based on the above information, is given in Table 5.

Table 5

Sources of Ores for the Vajskova' Smelter in Czechoslovakia
1953

Metric Tons

| Mine | Estimate of Ore Sent to Vajskova' | Antimony Metal a/ Equivalent |
|---|---|---|
| Vajskova' | 28,000 | 500 |
| Chuchma | 50,400 | 900 |
| Dubrava, Pezinok | 11,200 | 200 |
| Total | 89,600 | 1,600 |

a. Based on 56 tons of ore for 1 ton of metal. See input methodology, Appendix B.

3. East Germany.

Antimony is mined, milled, and smelted in the Oberboehmsdorf operation at Schleiz in Thuringia. This operation is small, and its future appears uncertain because of its limited reserves, which appear sufficient to carry even this small operation only through 1955. 48/ Before the smelting facilities were built the ore mined at Oberboehmsdorf had to be sent to Czechoslovakia for smelting. 49/ From 1951 through 1953 this operation produced a total of 412 tons of antimony; its annual production was almost identical in the last 2 years, possibly indicating a leveling off at around 150 tons. 50/ There are no indications of the new deposits which appear to be needed to furnish ore for this smelter after 1955. Details of the Oberboehmsdorf operation are summarized in Table 6.*

4. Communist China.

Information on antimony in Communist China presents many complex problems. Reserves of antimony in the ground are extremely large, estimated in 1945 at 3,802,810 metric tons of metal. 51/ Even under the highly improbable assumption that no added reserves will be discovered, this amount would last some 360 years at present rates of extraction. Another problem lies in the wide dispersion of deposits and mines throughout seven provinces. The five provinces with the largest reserves are shown in Table 7.**

An additional complicating factor is the large number of mines, at least 40, scattered throughout the 7 antimony provinces. About 25 of these mines are located in Hunan Province, which accounts for about four-fifths of total production. Of these, the Hsi-K'uang-Shan mines are the major producers. Although there is insufficient information to account for the ore output of the other individual mines, group tonnages can be accounted for at the smelter level. The known deposits and mines for all seven provinces are listed in Table 8.***

* Table 6 follows on p. 18.
** Table 7 follows on p. 19.
*** Table 8 follows on p. 20.

Table 6

Production of Primary Antimony
at Oberboehmsdorf in East Germany
1950-53

| | Production (Metric Tons) | Employment (Full-Time Employees) | Facilities | Reserves |
|---|---|---|---|---|
| 1950 | 0 | 0 | A mine, mill, and smelter, h/ i/ at Schleiz (50°34' N - 11°48' E). Smelting facilities were built in 1949. | Reserves are small, even for this small metal output. Reserves in 1953 are reported as containing only 233 tons of antimony. The ore is, however, very high grade. h/ |
| 1951 | 109 a/ | 140 b/ | | |
| 1952 | 153 c/ d/ | 200 e/ | | |
| 1953 | 150 f/ | 200 g/ | | |

a. 52/
b. 53/
c. 54/
d. 55/
e. 56/
f. 57/
g. Based on 1952.
h. 58/ Source classifies the reserves in this way: proved, 90 tons; probable, 111 tons; possible, 32 tons.
i. 59/

Table 7

Reserves of Antimony
in Communist China, by Provinces a/
1945

| Province | Metric Tons of Metal |
|---|---|
| Hunan | 1,995,500 |
| Kwangtung | 1,183,000 |
| Kwangsi | 66,500 |
| Kweichow | 509,810 |
| Yunnan | 48,000 |
| Total | 3,802,810 |

a. 60/

A final factor that complicates quantification of antimony production in Communist China is the great potentiality of this country to produce this metal. At one time China produced over one-half of the world's supply of antimony. In 1929 its production exceeded 20,000 tons. 61/ Some producing units -- both mines and smelters -- were destroyed, however, by the Japanese and later by internal warfare in 1943. The most important casualty is believed to have been the large smelter operation at Chang-sha, which was the largest in China prior to 1940. Chang-sha was captured by the Japanese in 1944, and its smelters were wrecked. 62/ Rather than rebuild them, the Chinese erected new smelters at the large Hsi-k'uang-shan mining operation, thus eliminating the 90-mile haul to Chang-sha. As previously indicated, however, production of antimony in Communist China can be estimated at the smelter level.

The total smelter production in Communist China in 1953 is estimated to have been about 11,000 tons. The location of the smelters, their outputs, and the apparent mine-smelter pattern are summarized in Table 9.*

* Table 9 follows on p. 21.

Table 8

Antimony Mines and Deposits in Communist China

| Province | Mine or Deposit | Town | Location |
|---|---|---|---|
| Hunan a/* b/ | Hsi-k'uang-shan | Hsin-hua | 27°46' N - 111°30' E |
| | San-chien-feng | Hsin-hua | 27°33' N - 111°24' E |
| | Mao-tzu-ling | Hsin-hua | 27°32' N - 111°32' E |
| | Pei-ch'i | Hsin-hua | 28°09' N - 111°45' E |
| | Lung-shan | Shao-yang | 27°30' N - 111°46' E |
| | Hou-tung-ch'ung | Shao-yang | 27°14' N - 111°28' E |
| | Chiang-ch'i | Shao-yang | 27°30' N - 111°45' E |
| | Pan-ch'i | I-yang | 28°29' N - 111°56' E |
| | Wang-chia-ch'ung | I-yang | 28°23' N - 111°45' E |
| | Hsi-ch'ung | I-yang | 28°35' N - 112°20' E |
| | Liao-chia-p'ing | An-hua | 28°08' N - 111°39' E |
| | Kan-tzu-yuan | An-hua | 28°08' N - 111°39' E |
| | Hua-pan-ch'i | An-hua | 28°12' N - 111°05' E |
| | Cha-tzu-ch'i | An-hua | 28°08' N - 111°39' E |
| | T'ien-chuang-wan | An-hua | 28°30' N - 111°40' E |
| | Ts'ung-ch'i | An-hua | 28°08' N - 111°39' E |
| | Lin-chia-ch'ung | An-hua | 28°08' N - 111°39' E |
| | Tseng-chia-ch'i | Hsu-p'u | 27°53' N - 110°40' E |
| | Kuan-yin-t'ang | Hsu-p'u | 27°53' N - 110°40' E |
| | Chiang-ch'i-lung | Hsu-p'u | 27°53' N - 110°40' E |
| | Niu-t'ou-chai and Hsien-chiang-ch'ung | Tung-an | 26°20' N - 111°14' E |
| | Heng-ch'ung | Tung-an | 26°20' N - 111°14' E |
| | Chiang-k'ou | Hsin-ning | 26°31' N - 110°48' E |
| | Lung-k'ou | Hsin-ning | 26°31' N - 110°48' E |
| Kwangtung a/ b/ | Lo-chia-wan | Lo-ch'ang | 25°22' N - 113°31' E |
| | T'ien-tzu-ling | Ch'u-chiang | 24°43' N - 113°10' E |
| Kwangsi a/ | Fu-jung-ch'ang | Ho-ch'ih | 24°41' N - 107°53' E |
| | Li-t'ang | Pin-yang | 23°07' N - 109°10' E |
| | T'ien-ching-ling | Wu-ming | 23°07' N - 108°19' E |
| Kweichow a/ | Huo-shao-chai | Tu-chiang | 25°42' N - 108°11' E |
| | Pa-meng | Jung-chiang | 25°46' N - 108°26' E |
| | Fan-ching-shan | Chiang-k'ou | 27°55' N - 108°51' E |
| | Miao-lung-ch'ang | San-tu | 26°03' N - 107°58' E |

* Footnotes for Table 8 follow on p. 21.

Table 8

Antimony Mines and Deposits in Communist China
(Continued)

| Province | Mine or Deposit | Town | Location |
|---|---|---|---|
| Yunnan a/ | Tu-pi and Kuo-hua | K'ai-yuan | 23°36' N - 103°07' E |
| | Mao-shan | Wen-shan | 23°13' N - 103°55' E |
| Kirin a/ | Ta-huang-kou | Tun-hua | 43°14' N - 128°13' E |
| | Wan-p'ao-ho-tzu | An-t'u | 42°51' N - 128°22' E |
| Liaoning a/ | Man-pao | An-t'u | 42°40' N - 128°30' E |

a. 63/
b. 64/

Table 9

Estimated Smelter Production of Primary Antimony in Communist China
1953

| Province | Smelter | Location | Estimated Output (Metric Tons of Metal) | Remarks |
|---|---|---|---|---|
| Hunan | Hsi-k'uang-shan | 27°46' N - 111°30' E (Hsin-hua) | 7,200 a/* | The North Smelter, smelting ores from other mines as well as its own, is reported to have a capacity of 200 tons of metal per month. The South Smelter, treating the ores from other mines, has a capacity of 400 tons metal per month. Both smelters have their own power plants. a/ |

* Footnotes for Table 9 follow on p. 23.

Table 9

Estimated Smelter Production of Primary Antimony in Communist China
1953
(Continued)

| Province | Smelter | Location | Estimated Output (Metric Tons of Metal) | Remarks |
|---|---|---|---|---|
| Hunan | Forty or fifty small smelters. b/ | Scattered throughout the province. b/ | 1,000 b/ c/ d/ | Though ore containing 3,000 tons to 4,000 tons of metal is sent to the South Smelter at Hsi-k'ang-shan, there are numerous small smelters which treat ore from the mines listed in Table 8. Several such smelters are located at Sinhwah-sien (27°30' N - 111°30' E), using the roasting and reduction process, c/ and one smelter is located at Takantun (25°48' N - 113°02' E). b/ A smelter was in operation prior to 1940 at the Pan-hsi mine (28°39' N - 111°56' E). d/ |
| Kwangtung | Ju-yuan | 24°46' N - 113°16' E (Ju-yuan) | 1,200 a/ | The second largest antimony operation in China. One smelter was in operation and another was being constructed in 1948. A large power plant was under construction in 1948. a/ |

Table 9

Estimated Smelter Production of Primary Antimony in Communist China
1953
(Continued)

| Province | Smelter | Location | Estimated Output (Metric Tons of Metal) | Remarks |
|---|---|---|---|---|
| Kwangsi | Liu-chou | 24°41' N - 107°53' E (Ho-chih) | 1,000 d/ | An up-to-date smelter which handles ores from the Ho-chih Nantan area. |
| All Others | Numerous small smelters | | 600 | Four small reduction furnaces are located at Antu in Liaoning Province. d/ Other locations are not known. |
| Total | | | 11,000 | |

a. 65/
b. 66/
c. 67/
d. 68/

Antimony production in Communist China in the next 5 years is capable of reaching a level of 14,000 tons to 17,000 tons of metal annually. Such development may be prevented more by reasons of demand than of supply. Supplies in the Soviet Bloc are now more than adequate -- measured against consumption of 11,500 tons in 1953 -- and there has been no export market to absorb larger production. Under these circumstances, it is unlikely that added resources will be expended to increase production.

C. Production.

Estimated production of antimony in each of the four producing countries of the Soviet Bloc -- the USSR, Czechoslovakia, East Germany, and Communist China -- is given in Table 10.

Table 10

Estimated Smelter Production of Primary Antimony in the Soviet Bloc
1948-53

Metric Tons

| Smelter | 1948 | 1949 | 1950 | 1951 | 1952 | 1953 |
|---|---|---|---|---|---|---|
| USSR | | | | | | |
| Kadamshay a/* | 1,500 | 1,500 | 2,000 | 3,000 | 3,500 | 3,500 |
| Turgay a/ | 500 | 500 | 500 | 1,000 | 1,500 | 1,500 |
| Total | 2,000 | 2,000 | 2,500 | 4,000 | 5,000 | 5,000 |
| Czechoslovakia | | | | | | |
| Vajskova' b/ | 3,600 | 1,500 | 1,500 | 1,500 | 1,500 | 1,600 |
| Pribram b/ | 500 | 500 | 500 | 500 | 500 | 700 |
| Total | 4,100 | 2,000 | 2,000 | 2,000 | 2,000 | 2,300 |
| East Germany | | | | | | |
| Oberboehmsdorf c/ | 0 | 0 | 0 | 109 | 153 | 150 |
| Communist China d/ | | | | | | |
| Hsi-k'uang-shan | 0 | 1,500 | 3,000 | 5,300 | 7,100 | 7,200 |
| Ju-yuan | 500 | 250 | 900 | 1,000 | 1,100 | 1,200 |
| Others | 2,750 | 2,250 | 2,100 | 1,700 | 1,800 | 2,600 |
| Total | 3,250 | 4,000 | 6,000 | 8,000 | 10,000 | 11,000 |
| Bloc Total | 9,350 | 8,000 | 10,500 | 14,110 | 17,150 | 18,450 |

* Footnotes for Table 10 follow on p. 25.

Table 10

Estimated Smelter Production of Primary Antimony
in the Soviet Bloc
1948-53
(Continued)

a. Range of error: plus or minus 20 percent. 1953 figures are from page 14. Estimates for earlier years are based on size, location, reserves, and nature of mining and smelting operations. 69/
b. Range of error: plus or minus 20 percent. 1953 figures are from page 16. Except for 1948 production, which is a published figure, 70/ production for earlier years is based on information in 71/.
c. These figures are considered documentary. 72/
d. The 1948 production total is a published figure. 73/ For the years 1949-53 the range of error is plus or minus 20 percent. The 1949-53 totals are based on the following projection of the National Resources Commission of China:

| | Metric Tons | | | | |
|---|---|---|---|---|---|
| | 1948 | 1949 | 1950 | 1951 | 1952 |
| Hsi-k'uang-shan | 500 | 3,000 | 5,000 | 8,000 | 10,000 |
| Ju-yuan | 300 | 500 | 1,500 | 1,500 | 1,500 |
| Total from Others | 3,200 | 4,500 | 3,500 | 2,500 | 2,500 |
| Total | 4,000 | 8,000 | 10,000 | 12,000 | 14,000 |

The NRC totals are changed as follows: 1948 production is listed as 3,251, a published figure for actual production. 1949 is scaled down from 8,000 tons to 4,000 tons, the estimate by the US Bureau of Mines for that year. 74/ This 4,000-ton overestimate is also removed from the 1950, 1951, and 1952 figures. The amounts for Hsi-k'uang-shan, Ju-yuan, and "Total from Others" are the same proportions projected by the NRC but applied to the revised totals, except for the year 1948 when no production is attributed to Hsi-k'uang-shan, which was under construction. The 1953 production is based on Table 9.

D. Trade.

In general terms the pattern of trade in antimony is quite simple: Communist China and Czechoslovakia are exporters, the other countries of the Soviet Bloc are importers. Since Communist China's domestic demands take only a negligible part of its output, almost all of its production is exported to the USSR, 75/ portions of which are reexported to the European Satellites. 76/ Czechoslovakia appears to supply the other European Satellites to the extent that its exportable surplus of about 1,000 tons will allow. These exports go principally to East Germany, and to a lesser extent, to Poland, Rumania, Bulgaria, and Albania. 77/ In addition, small tonnages have been imported by the Soviet Bloc from non-Bloc countries.

Imports of primary antimony by countries of the Soviet Bloc, in 1948-53, are given in Table 11* and exports of primary antimony by countries of the Soviet Bloc, in 1948-53, are given in Table 12.** It will be noted that the USSR is both an importer (from China) and an exporter (to the European Satellites). Available information is too fragmentary to permit a more complete quantitative estimate of intra-Bloc trade.

E. Total Available Supply.

Estimates of the total available supply of antimony in each of the countries of the Soviet Bloc for the years 1948-53 can be made by combining estimates of production, imports, and exports. Czechoslovakia has produced about 2,000 tons per year over the 6-year period, of which about 1,000 tons annually are exported to other European Satellites. East Germany, with no production until 1951, imported all of its supplies in 1948-50. With the beginning of East German production, imports appear to have leveled off at about 900 tons annually, giving East Germany a total supply of slightly over 1,000 tons per year from 1951 to 1953. All of Poland's supply comes from imports, which have increased from about 100 tons in 1948 to 400 tons in 1953. Hungary's supply is also imported, reaching a level of about 300 tons by 1953. The small tonnages required by Rumania, Bulgaria, and Albania, which together amount to no more than 100 tons, also must be imported.

* Table 11 follows on p. 27.
** Table 12 follows on p. 28.

Table 11

Estimated Imports of Primary Antimony by Countries of the Soviet Bloc a/
1948-53

Metric Tons

| Year | East Germany b/ | Hungary c/ | Poland d/ | Bulgaria, Rumania, and Albania e/ | USSR f/ | Total |
|---|---|---|---|---|---|---|
| 1948 | 550 | 0 | 100 | 100 | 3,000 | 3,750 |
| 1949 | 700 | 50 | 300 | 100 | 3,700 | 4,850 |
| 1950 | 900 | 200 | 300 | 100 | 6,000 | 7,500 |
| 1951 | 900 | 250 | 450 | 100 | 7,800 | 9,500 |
| 1952 | 900 | 300 | 400 | 100 | 9,300 | 11,000 |
| 1953 | 900 | 300 | 400 | 100 | 10,300 | 12,000 |

a. Range of error: plus or minus 20 percent. Includes small tonnages from Yugoslavia and Turkey.
b. 78/. 1952 and 1953 based on 1951.
c. 79/. 1952 and 1953 based on 1951.
d. 80/. 1952 and 1953 based on 1951.
e. An estimated annual average for the 6-year period.
f. Based on Chinese exports. There is no evidence of shipments of Chinese antimony to countries outside the Soviet Bloc.

Although production of primary antimony in the USSR has increased from about 2,000 tons to 5,000 tons from 1948 to 1953, the USSR has received increasingly larger quantities from Communist China each year. In 1948, imports from China are estimated to have been about 3,000 tons, but in 1953 they were about 10,300 tons. As a result, the total available supply of primary antimony in the USSR has more than tripled in the 6-year period. On the other hand, the total available supply of primary antimony in Communist China is only a small fraction of its production, reflecting its low level of industrial development. Estimates of total available supply of primary antimony in each country in the Soviet Bloc, 1948-53, are presented in Table 13.*

* Table 13 follows on p. 28.

Table 12

Estimated Exports of Primary Antimony by Countries of the Soviet Bloc a/
1948-53

Metric Tons

| Year | Communist China b/ | Czechoslovakia c/ | USSR d/ | Total |
|---|---|---|---|---|
| 1948 | 3,000 | 3,000 | 500 | 6,500 |
| 1949 | 3,700 | 1,000 | 400 | 5,100 |
| 1950 | 6,000 | 1,000 | 0 | 7,000 |
| 1951 | 7,800 | 1,000 | 300 | 9,100 |
| 1952 | 9,300 | 1,000 | 300 | 10,600 |
| 1953 | 10,300 | 1,000 | 300 | 11,600 |

a. Range of error: plus or minus 20 percent.
b. Based on Chinese production.
c. 81/. 1952 and 1953 based on 1951.
d. 82/. 1952 and 1953 based on 1951.

Table 13

Estimated Total Available Supply of Primary Antimony in Each Country of the Soviet Bloc a/
1948-53

Metric Tons

| Year | Czechoslovakia | East Germany | Hungary | Poland | Bulgaria, Rumania, and Albania | Total European Satellites | USSR | China | Total Soviet Bloc |
|---|---|---|---|---|---|---|---|---|---|
| 1948 | 1,100 | 550 | 0 | 100 | 100 | 1,850 | 4,500 | 250 | 6,600 |
| 1949 | 1,000 | 700 | 50 | 300 | 100 | 2,150 | 5,300 | 300 | 7,750 |
| 1950 | 1,000 | 900 | 200 | 300 | 100 | 2,500 | 8,500 | 0 | 11,000 |
| 1951 | 1,000 | 1,010 | 250 | 450 | 100 | 2,810 | 11,500 | 200 | 14,510 |
| 1952 | 1,000 | 1,050 | 300 | 400 | 100 | 2,850 | 14,000 | 700 | 17,550 |
| 1953 | 1,300 | 1,050 | 300 | 400 | 100 | 3,150 | 15,000 | 700 | 18,850 |

a. Production plus imports minus exports.

## II. Consumption.

### A. Aggregates.

From 1948 to 1953 the total available supply of primary antimony in the European Satellites increased from 1,850 tons in 1948 to 3,150 tons in 1953. Because of numerous allusions to shortages of antimony in individual countries, it is concluded that antimony supplies did not exceed requirements during this period. 83/ Available supply, therefore, is equated with consumption for each of these years in the European Satellites.

Although the evidence indicates that available supply is equivalent to consumption in the European Satellites, the same method cannot be applied to the USSR. In 1953, for example, production of antimony in the USSR is estimated to have been 5,000 tons. In addition, the USSR imported an estimated 10,300 tons from Communist China, of which about 300 tons were reexported to the European Satellites. The total available supply of antimony in the USSR, therefore, was about 15,000 tons.* On the other hand, production estimates of antimony-containing products for 1953, outlined below, indicate an output much lower than that to be expected from a consumption of 15,000 tons of primary antimony. The possibility that the USSR uses greater percents of antimony than the US or other countries is not borne out by a comparative analysis of specifications for antimony alloys.

Inasmuch as the equation -- production plus imports minus exports equals consumption -- is not considered applicable to the USSR, an alternative method was used to estimate consumption of primary antimony. For the years 1948 to 1952, production estimates of 13 major products employing antimony bearings are available for both the USSR and the European Satellites. Approximately three-fourths of these products consuming antimony are estimated to have

* There are no known exports of primary antimony from the USSR to non-Soviet Bloc countries.

been produced in the USSR in the 1948-53 period.* Production estimates of batteries are also available for both the USSR and the European Satellites. 85/ Of these, 64 percent are estimated to have been produced in the USSR. The production of miscellaneous items such as solder, type metal, and cable sheathing is assigned the same ratio as the consumers of bearings, or 75 percent and 25 percent.** A weighted average of these three major consuming categories -- bearings, batteries, and miscellaneous items -- was then employed to obtain an over-all ratio between consumption of antimony in the European Satellites and the USSR.*** The ratio for each of the years during the 1948-53 period was approximately the same, and the data indicate that the USSR consumed 70 percent and the European Satellites 30 percent of the total 1948-53 consumption of primary antimony in the Soviet Bloc.**** The application of this ratio to the 1948 to 1953 supply data for the European Satellites (considered to be equivalent to their consumption) yields a consumption series for the USSR, based on its production of antimony-consuming products.

Although the estimates for the USSR so derived include antimony in both metallic and nonmetallic uses, the methodology does not account for antimony used in small-arms ammunition. Production estimates of such ammunition are available for the USSR, and the content of the standard bullet core is known to be a

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* Estimates of production are available for steam locomotives, machine tools, trucks, merchant ships, electric motors, turbines, tractors, mining locomotives, passenger cars, electric locomotives, freight cars, railway passenger cars, and naval vessels. 84/ Within this bearing category, because no logical weighting system could be devised, a simple arithmetic average was employed to establish the proportions produced in the USSR and the European Satellites.

** On the basis of a closer similarity to the bearing category, which represents a wider range of industrial production than the battery component. There are no direct production estimates available for components of this group upon which independent estimates can be based.

*** Weights employed were 33, 53, 14, respectively, the distribution of consumption in the bearing, battery, and miscellaneous categories in the US in 1950.

**** It is believed that this ratio is sufficiently accurate to make unnecessary the consideration of a margin of error in computations based on it.

standard 90 to 10 lead-antimony mix. 86/ With these data it is possible to estimate the antimony consumed in producing ammunition. In 1952 the USSR produced about 1.7 billion rounds of 7.62-mm ammunition and 0.3 billion rounds of 12.7 mm ammunition. 87/ Since each 7.62-mm round contains 0.0015 pounds of antimony and each 12.7-mm round contains 0.005 pounds, 88/ the total antimony consumption in small-arms ammunition would be 1,820 tons.

Probably no more than 60 percent of the total thus consumed is primary antimony, the remainder being reclaimed or secondary metal. It is therefore estimated that production of ammunition consumed approximately 1,000 tons of primary antimony in 1952. Consumption in 1953 is estimated at the same level. For the years 1948-51, however, production of small-arms ammunition in the USSR is estimated to have averaged about 1 billion rounds annually. 89/ Consumption of primary antimony is thus estimated to have been about 500 tons annually in this period. These quantities are included in the estimated consumption of primary antimony in the USSR during 1948-53, shown in Table 14.*

B. Primary Antimony in the USSR.

Of the 7,350 tons of antimony estimated to have been consumed by the USSR in 1953 aside from that consumed in ammunition, there is no direct information to indicate how much goes into the many nonmetallic compounds such as antimony sulfide, trioxide, and tetroxide. In the US the nonmetallic uses account for from 30 percent to 40 percent of total consumption. Nonmetallic compounds are lavishly employed in the US in consumer goods such as bathroom and kitchen equipment -- uses which are new compared to the mature metallic uses. The counterpart figure for the USSR, therefore, is estimated to be much lower -- probably about 10 percent, about 730 tons in 1953.

The consumption pattern for the USSR is estimated in Table 15,** on the basis of the estimated breakdown between metallic and nonmetallic uses, the amounts estimated directly to have been used in ammunition, and the probable breakdown within the metallic category. In 1948-53, batteries consumed about 40 percent; bearings, 27 percent; solder, type metal, and cable sheathing, about

* Table 14 follows on p. 32.
** Table 15 follows on p. 33.

Table 14

Estimated Consumption of Primary Antimony
in the Soviet Bloc a/
1948-53

Metric Tons

| Year | European Satellites b/ | USSR c/ | Total |
|---|---|---|---|
| 1948 | 1,850 | 4,850 | 6,700 |
| 1949 | 2,150 | 5,550 | 7,700 |
| 1950 | 2,500 | 6,300 | 8,800 |
| 1951 | 2,810 | 7,100 | 9,910 |
| 1952 | 2,850 | 7,650 | 10,500 |
| 1953 | 3,150 | 8,350 | 11,500 |

a. Consumption in Communist China is negligible and is not considered in this table. Because estimates of consumption are based essentially on total supply (see Appendix B), both the degree and direction of error are determined generally by the range of error in the estimates of total supply.
b. Based on Table 13.
c. Derived from the ratio between antimony consumers in the European Satellites and the USSR applied to consumption in the European Satellites, plus consumption of antimony in small-arms ammunition (500 tons annually from 1948 to 1951, and 1,000 tons annually in 1952 and 1953).

11 percent; ammunition, 10 percent; and antimony compounds, 9 percent. For the entire Soviet Bloc, it is estimated that in 1953 about 9,450 tons were consumed in metallic uses (3,100 tons in bearings; 5,110 tons in batteries; 1,230 tons in solder, type metal, and cable sheathing); 1,050 tons in antimony compounds; and 1,000 tons in ammunition.

## IV. Surplus.

There is no direct evidence to indicate the quantities of antimony that were stockpiled during 1948-53. For these years, however, a total of about 76,260 tons of antimony is estimated to have

Table 15

Estimated Consumption of Primary Antimony by Major Categories in the USSR
1948-53

Metric Tons

| Year | Total a/ | Metallic | | | | Antimony Compounds d/ | Ammunition e/ |
|---|---|---|---|---|---|---|---|
| | | Total b/ | Bearings c/ | Batteries c/ | Miscellaneous c/ | | |
| 1948 | 4,850 | 3,915 | 1,290 | 2,075 | 550 | 435 | 500 |
| 1949 | 5,550 | 4,545 | 1,500 | 2,410 | 635 | 505 | 500 |
| 1950 | 6,300 | 5,220 | 1,725 | 2,765 | 730 | 580 | 500 |
| 1951 | 7,100 | 5,940 | 1,960 | 3,150 | 830 | 660 | 500 |
| 1952 | 7,650 | 5,985 | 1,975 | 3,170 | 840 | 665 | 1,000 |
| 1953 | 8,350 | 6,615 | 2,180 | 3,505 | 930 | 735 | 1,000 |

a. Based on Table 14.
b. Basis of estimate: 90 percent of total antimony consumption, exclusive of ammunition. Range of error: plus or minus 20 percent.
c. Basis of estimate: the consumption ratio of 53-33-14 in the bearings, batteries, and miscellaneous categories in the US in 1950 in metallic uses. Miscellaneous includes solder, type metal, cable sheathing, collapsible tubes and foils. Range of error: plus or minus 30 percent.
d. Basis of estimate: 10 percent of total antimony consumption exclusive of ammunition. Range of error: plus or minus 20 percent.
e. Basis of estimate: (small-arms ammunition production) x (antimony content in bullet core). Range of error: plus or minus 50 percent. 1948-51, an annual average.

been available to the Soviet Bloc. During the same period, consumption is estimated to have been about 55,110 tons. The exact status of this 21,000-ton surplus is, of course, not known. As indicated previously, there is evidence that the large Chinese output does not remain in China, but is absorbed by the USSR. 90/ It is estimated, therefore, that about 20,000 tons of antimony (allocating about one month's supply, or 1,000 tons, for consumers' stocks) has found its way into strategic stockpiles. Should Chinese supplies be lost to the Soviet Bloc in time of war, a stockpile of 20,000 tons, added to production in the USSR and the European Satellites, would amount to nearly a 5-year supply at current rates of consumption. If both China and the European Satellites were lost to the USSR, a stockpile of 20,000 tons would last nearly 6 years, when added to current Soviet production. With no Soviet production, this quantity would last only a little over 2 years at current rates of consumption. The magnitude of the surplus of antimony is estimated in Table 16.*

V. Inputs.

Except for the number of workers at the Oberboehmsdorf antimony mine and smelter operation, 91/ estimates of the various resources consumed by the antimony industry in the Soviet Bloc must be made largely by indirect methods. A detailed explanation of the methods used for making estimates of required inputs of ore treated, coking coal, electric power, labor, and water is given in Appendix B. Inputs required by the Bloc for the years 1948-53 follow in Table 17.**

* Table 16 follows on p. 35.
** Table 17 follows on p. 36.

Table 16

Estimated Supply, Consumption, and Surplus of Primary Antimony in the Soviet Bloc 1948-53

| Year | Estimated Total Available Supply a/ | Estimated Total Consumption b/ | Surplus c/ |
|---|---|---|---|
| 1948 | 6,600 | 6,700 | (-100) |
| 1949 | 7,750 | 7,700 | 50 |
| 1950 | 11,000 | 8,800 | 2,200 |
| 1951 | 14,510 | 9,910 | 4,600 |
| 1952 | 17,550 | 10,500 | 7,050 |
| 1953 | 18,850 | 11,500 | 7,350 |
| Six-Year Total | 76,260 | 55,110 | 21,150 |

a. Based on Table 13.
b. Based on Table 14.
c. It is believed that because the direction and degree of the range of error in consumption estimates is determined generally by the range of error in supply estimates and because the ratio used to determine consumption in the USSR is accurate within very narrow limits, the range of error in the estimates of surplus does not exceed plus or minus 25 percent.

Table 17

Estimated Major Inputs in the Mining and Smelting of Primary Antimony in the Soviet Bloc 1948-53

| | 1948 | 1949 | 1950 | 1951 | 1952 | 1953 |
|---|---|---|---|---|---|---|
| USSR | | | | | | |
| Production of Antimony (Metric Tons) a/* | 2,000 | 2,000 | 2,500 | 4,000 | 5,000 | 5,000 |
| Ore Treated (Metric Tons) b/ | 112,000 | 112,000 | 140,000 | 224,000 | 280,000 | 280,000 |
| Coal (Metric Tons) c/ | 4,400 | 4,400 | 5,500 | 8,800 | 11,000 | 11,000 |
| Electric Power (Thousand KWH) d/ | 7,200 | 7,200 | 9,000 | 14,400 | 18,000 | 18,000 |
| Labor (Man-Years) e/ | 2,100 | 2,100 | 2,750 | 4,200 | 5,300 | 5,300 |
| Fresh Water (Thousand Tons) f/ | 1,120 | 1,120 | 1,400 | 2,240 | 2,800 | 2,800 |
| Czechoslovakia | | | | | | |
| Production of Antimony (Metric Tons) a/ | 4,100 | 2,000 | 2,000 | 2,000 | 2,000 | 2,300 |
| Ore Treated (Metric Tons) b/ | 230,000 | 112,000 | 112,000 | 112,000 | 112,000 | 131,000 |
| Coal (Metric Tons) c/ | 9,000 | 4,400 | 4,400 | 4,400 | 4,400 | 5,000 |
| Electric Power (Thousand KWH) d/ | 14,760 | 7,200 | 7,200 | 7,200 | 7,200 | 8,300 |
| Labor (Man-Years) e/ | 4,300 | 2,100 | 2,100 | 2,100 | 2,100 | 2,500 |
| Fresh Water (Thousand Tons) f/ | 2,300 | 1,120 | 1,120 | 1,120 | 1,120 | 1,300 |
| East Germany | | | | | | |
| Production of Antimony (Metric Tons) a/ | 0 | 0 | 0 | 109 | 153 | 150 |
| Ore Treated (Metric Tons) b/ | 0 | 0 | 0 | 6,100 | 8,570 | 8,400 |
| Coal (Metric Tons) c/ | 0 | 0 | 0 | 240 | 340 | 330 |
| Electric Power (Thousand KWH) d/ | 0 | 0 | 0 | 400 | 550 | 550 |
| Labor (Man-Years) e/ | 0 | 0 | 0 | 140 g/ | 200 h/ | 200 |
| Fresh Water (Thousand Tons) f/ | 0 | 0 | 0 | 60 | 90 | 80 |

* Footnotes for Table 17 follow on p. 37.

Table 17

Estimated Major Inputs in the Mining and Smelting of Primary Antimony in the Soviet Bloc 1948-53 (Continued)

| | 1948 | 1949 | 1950 | 1951 | 1952 | 1953 |
|---|---|---|---|---|---|---|
| Communist China | | | | | | |
| Production of Antimony (Metric Tons) a/ | 3,250 | 4,000 | 6,000 | 8,000 | 10,000 | 11,000 |
| Ore Treated (Metric Tons) b/ | 112,900 | 137,100 | 205,600 | 274,200 | 342,800 | 377,000 |
| Coal (Metric Tons) c/ | 7,150 | 8,800 | 13,200 | 17,600 | 22,000 | 24,200 |
| Electric Power (Thousand KWH) d/ | 11,700 | 14,500 | 21,600 | 29,000 | 36,000 | 40,000 |
| Labor (Man-Years) e/ | 8,100 | 10,000 | 15,000 | 20,000 | 25,000 | 27,500 |
| Fresh Water (Thousand Tons) f/ | 1,100 | 1,400 | 2,100 | 2,700 | 3,400 | 3,800 |

a. Based on Table 10.
b. Range of error: plus or minus 20 percent. (See Appendix B.)
c. In terms of Soviet standard fuel equivalent of 12,600 Btu per pound. Range of error: plus or minus 20 percent. (See Appendix B.)
d. Range of error: plus or minus 20 percent. (See Appendix B.)
e. Range of error: plus or minus 20 percent for USSR and Czechoslovakia, and plus or minus 30 percent for Communist China. German employment figures are believed to be documentary. (See Appendix B.)
f. Range of error: plus or minus 30 percent. (See Appendix B.)
g. 92/
h. 93/

# APPENDIX A

## ANTIMONY ALLOYS AND THEIR USES

Table 18

Uses of Selected Antimony Alloys in the US a/*

| Name of Alloy | Antimony Content (Percent) | Uses |
|---|---|---|
| Regulus Metals | 6.0 to 8.0 | Chemical plant equipment. |
| | 3.0 to 10.0 | Chemical equipment. |
| | 10.0 to 12.0 | Bearings. |
| Aluminum Solder | 2.0 | Solder. |
| High-Grade Bearings | 2.0 to 9.0 | High-grade bearings. |
| Packing (Valve) | 24.0 | Valve packing. |
| Naval Bronze | 16.0 | Bearings. |
| Grapho Babbitt | Sn, Pb, Sb, 0.3 graphite | Bearings for electric motors, blowers, high-speed transmissions, high velocity and pressures. |
| | 0.4 graphite | Bearings for diesel engines, heavy-duty compressors; heavy duty, all kinds of shocks and velocities. |
| Bronze Composition "M" USN | 0.25 | Valve castings, manifolds, cocks. |
| Aciment Hard Lead Alloy | 4.5 to 5.5 | Valves, pumps, fittings handling corrosive chemicals. |
| Bohn No. 4 | 4.5 | Aircraft engine linings. |
| Hoyt Arrow | Sn, Cu, Sb | Bearings for heavy loads and high-speeds, fans, stonecrushers, mining machinery. |
| Armature Babbitt | Sn, Cu, Ni, Sb | Armature bearings, marine turbine bearings. |
| Crusher Babbitt | Sn, Cu, Ni, Sb | Bearings for cement mills and mines, heavy loads. |
| More-Jones Crescent Babbitt | Cu, Sn, Sb | Heavy-duty bearings for rolling mills, paper mills. |
| Regent Babbitt | Sn, Sb | For relining railroad bearings. |
| Sovereign Babbitt | Sn, Cu, Sb | Internal combustion engine bearings. |
| Bosch Pb-7 | 15.0 | Bearing shells. |

* Footnote for Table 18 follows on p. 43.



[p 38 blank]

Table 18

Uses of Selected Antimony Alloys in the US
(Continued)

| Name of Alloy | Antimony Content (Percent) | Uses |
|---|---|---|
| Bunting No. 98 | 0.2 | Bearings for aircraft. |
| Walde-Loy No. 100 Metal | 5.3 | Battery cable terminals and lugs; resists $H_2SO_4$. |
| Deurance Metal | 44.5 (33.3 Sn, 22.2 Cu) | Locomotive bearings. |
| Electrotype | 4.0 | |
| Gas Engine Babbitt | (Sn, Sb, Pb) | |
| Glyco Turbo | 22.0 | Turbine bearings. |
| Heavy Bearings | 7.5 | |
| Heavy Axle Bearings | 6.0 | Axle bearings. |
| Lead Tape | 4.5 | |
| Marine Babbitt | 7.0 (72.0 Pb, 21.0 Sn) | Marine bearings. |
| Oil Engine Babbitt | (Sn, Pb, Sb) | Oil engine bearings. |
| Plumbite | (Sb, Sn, Pb) | Used in slow-running and light-weight machines. |
| Prince Metal No. 2 | 15.0 (85.0 Cu) | Hardware. |
| Propeller Bushing | 7.0 (69.0 Zn, 19.0 Sn, 5.0 Cu) | Propeller bushings. |
| Solders | 0.4 to 2.0 | |
| Spiauter | 8.0 (90.0 Sn, 2.0 Cu) | Hard zinc bearings. |
| Tin Foil | 0.5 | |
| Zinc Babbitts | 3.0 | |
| Die Casting Alloys | 2.0 to 17.0 | Light-duty bearings. |
| McAdams Alloys | 5.0 (70.0 Al) | Light alloy parts. |
| Auer Metal | 10.0 | Gas and cigarette lighters, sparking alloy. |
| Bearing Metals, Bronze | up to 2.0 | Bronze bearings (some). |
| Bearite | 16.75 | Bearings not subject to vibration or pounding. |
| Shaft Bearings (Pb base) | no percentage given | |

Table 18

Uses of Selected Antimony Alloys in the US
(Continued)

| Name of Alloy | Antimony Content (Percent) | Uses |
|---|---|---|
| Graphite Metal | 20.0 (80.0 Pb) | Crucibles, lubricants, lead pencils. |
| | 17.0 (68.0 Pb, 15.0 Sn) | Foundry facings, electric brush carbons. |
| Graphalloy Babbitt | (Graphite impregnated with Pb base Babbitt) | Bearings, electrical brushes. |
| Type Metal | 10.0 (90.0 Pb) | |
| Hard Lead | 0.5 | Valves, cocks, cable-sheathing. |
| | 1.5 | Valves, cocks, tank-linings. |
| Navy Antifriction Metals, 6 Grades: | 7.0 to 8.0 | Antifriction metal, bearings, automotive engine bearings -- for moderately severe service. |
| | 3.5 to 5.0 | Babbitt metal, aircraft engine bearings. |
| | 7.5 to 8.5 | Hard Babbitt, bearings, for moderately heavy pressures. |
| | 12.0 to 14.0 | Hard bearings -- for heavy pressure and high-speeds. 80.5 to 82.5 Sn. |
| | 9.5 to 10.5 | Electric motor bearings -- low pressures and high speeds. |
| | 14.0 to 16.0 Sb (79.0 to 81.0 Pb) | Cheap Babbitt -- for light service. |
| Bearing Metals | up to 23.0 | White metal. |
| Metal or Die Cast Bearings | 0.11 | Antifriction metal. |
| Packing, Piston | 73.0 to 76.0 Pb (10.0 to 15.0 Sb) | Metallic packing. |
| White Brass | 6.0 to 11.0 | Marine and automobile bearings. Hard, tough alloys. |
| Light Aircraft and Auto Parts | 2.4 | |
| Pattern Alloys | 13.0 | Bearings. |
| Plastic Metal | 8.6 | Bearings. |
| Pyrophoric Alloy | 10.0 (10.0 Mn) | Lighters for gas stoves, cigarette lighters; violent sparks. |

Table 18

Uses of Selected Antimony Alloys in the US
(Continued)

| Name of Alloy | Antimony Content (Percent) | Uses |
|---|---|---|
| Queens Metal | 7.0 | Resists tarnishing. |
| Regulus | 25.0 (75.0 Pb) | Acid valves, cocks, flanges, chemical apparatus. |
| Light Alloy | 0.2 | Ship parts, chemical industry, light fixtures. Resists sea-water corrosion. |
| Terne Metal | up to 2.0 | Terne plate, roofing, gasoline and oil tanks. Corrosion resisting. |
| | up to 1.8 (more tin 18.0) | Bearings. |
| Thermo-electric Nickel Babbitt | 7.5 | Babbitt service, bearings. |
| Type Metal | 10.0 to 28.0 | Type casting. French, English, German (up to 30 Sb). |
| British Navy Anti-friction Metals | 10.0 | Admiralty lining, plastic bearings. |
| Antifriction Metals | 9.0 | Special Admiralty bearings for heavy loads. |
| | 29.6 | Special Admiralty bearings for under-water. |
| German Navy Anti-friction Metals | 7.5 | Bearings. |
| Accumulator Metal | 0.8 | Bearings, battery plates. |
| Anode Metal | 6.0 (94.0 Pb) | Batteries, plates. |
| Battery Plates | 6.0 (94.0 Pb) | |
| Pinkus Brass | 0.32 | Hardware, fittings. |
| Condenser Foil | 1.0 | Accumulators. |
| Chichier Metal | 11.0 | Bearings, fuses. |
| Chinese Speculum | 8.5 (81.0 Cu, 11.0 Sn) | Mirrors, optical grading. |
| Diesel Bearings | 15.0 | Bearings for diesel engines. |
| Dutch White Metal | 8.8 | Bearings. |
| Semiplastic Bronze | (Mostly copper, 0.40 Sb) | Soft bronze bearings, water-pump bearings. |
| Aluminum Alloy, Red Brass | (Mostly copper, 0.75 Sb) | Water-pump impellers, bushings, oil-lines, gasoline line fittings. |

Table 18

Uses of Selected Antimony Alloys in the US
(Continued)

| Name of Alloy | Antimony Content (Percent) | Uses |
|---|---|---|
| Babbitt | 4.0 to 5.0 Sb | Aircraft engine liners. |
| Babbitt | | Bearings, aircraft engine liners. |
| Connecting Rods | 6.0 to 7.5 | |
| Bearings | 7.0 to 8.5 | |
| Bearings for Large and Light Service | 9.25 to 10.75 | |
| Bearings for Light Service | 14.0 to 16.0 | |
| Brittania Metals (12 listed) | 4.0 to 16.0 | Bearings, pewter, tableware. |
| Ashberry Metal | 14.0 to 19.0 | Tableware, utensils. |

a. 94/

Table 19

Comparison of Uses of Antimony Alloys in the USSR and the US a/*

| USSR | US |
|---|---|
| Rolling mill bearings. | Heavy duty bearings for rolling mills, paper mills. |
| Valve guides. | Valve castings, manifolds, cocks. |
| Aircraft engine parts. | Aircraft engine bearings. |
| Heavy load, high temperature bearings and bushings. | Propeller bushings. |

* Footnote for Table 19 follows on p. 44.

Table 19

Comparison of Uses of Antimony Alloys in the USSR and the US
(Continued)

| USSR | US |
|---|---|
| Marine engineering parts. | Marine turbine bearings, marine bearings. Admiralty bearings for under water. |
| Lining bearings of petrol engines of main and big-end bearings of automobiles and tractors. | Automotive engine bearings, auto bearings. |
| Lining bearings of turbines, marine and stationary steam engines over 1200 hp, portable steam engines, electric motors, locomotives. | Marine bearings, Admiralty bearings for under water. |
| Linings and bushings for machine tools. | Machine tool bearings. |
| Lining bushings of internal combustion engines. | Internal combustion engine bearings. |
| Lining bearings of aircraft engines and high-power aircraft engines. | Aircraft engine bearings. |
| Lining bearings of railway wagons, wide and narrow gauge. | Railway freight and passenger cars. |
| Locomotive bearings. | Locomotive bearings, journal box bearings. |
| Turbine bearings. | Turbine bearings. |
| Bearings for diesel engines. | Bearings for diesel engines. |
| High leaded tin bronze bearings and bushings for high temperatures. Special acid-resistant bronze. | Bronze bearings. |
| Lining acid-proof apparatus, and in accumulator industry. | Chemical plant equipment, accumulators. |
| Type metal for printing. | Type metal for printing. |
| Soft solder for tinplate, iron, brass, copper, aircraft radiators, instruments, radio apparatus. | Solder for tinplate, electrical industry, radio, electronics, etc. |
| Cast and wrought aluminum alloys. | Light alloy parts. |

a. Based on Table 1 and Table 18.

APPENDIX B

## METHODOLOGY

Indirect methods of estimation have been used to supplement basic intelligence reports and are an integral part of estimates of consumption and input factors; they are less critical in estimates of production. In general terms the following methods have been employed.

1. Production.

Aggregates for producing countries, with the exception of East Germany, are not available, even in the form of percentages of a previous time period. Production aggregates are based, instead, on the summation of estimated production of individual smelters. Where possible, the quantities of ores coming to the smelters from mines have been estimated. In all instances, except for East Germany, these aggregates have been reconciled with data on production before 1948.

2. Consumption.

The first step in estimating aggregate consumption of antimony in the Soviet Bloc countries was to derive estimates of consumption in the European Satellites. Second, the ratio of consumption in the European Satellites to consumption in the USSR was computed on the basis of the distribution of antimony consumers within these countries. On the basis of this ratio, consumption in the USSR was derived from consumption in the European Satellites, to which was added estimates of primary antimony used in manufacturing small-arms ammunition.

3. Inputs.

Methods used in estimating resources consumed by the antimony mining industry are explained in detail below. In general, coefficients are based on Soviet Bloc data where available, for example, employment in antimony mining in East Germany and water requirements in China. Wherever direct data, such as electric power requirements, are not available, estimates are based on US experience.

a. Estimates of the Amount of Ore Treated.

The antimony content of the ore mined in the USSR has been estimated to average 3 percent, though some as low as 1.5 percent is believed to have been utilized. 95/ Three percent is also assumed to be the average content of the ores mined in Czechoslovakia and East Germany. In the milling of these ores, a recovery of 70 percent is estimated for the USSR, 96/ and this percentage also is applied to Czechoslovakia and East Germany. A recovery of 80 percent at the smelting level was estimated for 1946 in the USSR, and 85 percent is stated to be the smelting recovery coefficient at the Vasjova smelter in Czechoslovakia. 97/ Because the information concerning Vasjova is based on on-the-spot observation, and because there is no reason why recent Soviet smelting should be lower at this time, the smelter recovery coefficient of 85 percent is used for the USSR, and also for East Germany. With these coefficients -- 3 percent ore, 70 percent milling recovery, and 85 percent smelter recovery -- the following formula is used for these three countries:

$$\text{Tons of ore consumed} = \frac{\text{tons of antimony metal}}{0.03 \times 0.70 \times 0.85}$$

For the USSR, for example, for the year 1953:

$$\text{Tons of ore} = \frac{5{,}000}{(0.03)\ (0.70)\ (0.85)} = 280{,}000$$

On a per-ton basis, about 56 tons of ore must be treated to produce 1 ton of antimony metal.

For Communist China, different coefficients must be used. The Dolbear field team, retained by the National Resources Commission of China, on the basis of their study of antimony mining and smelting in China in 1946, arrived at the following 98/: average grade of ore, 4 percent*; mill recovery, 80 percent; smelter recovery, 90 percent. Using these coefficients in the same formula, Chinese production in 1953 of 11,000 tons of antimony would require the treatment of 377,000 tons of ore, or about 35 tons of ore for each ton of metal. This ratio is used to compute ore consumption for Communist China.

* Some Chinese ore is much richer, 5 percent to 10 percent antimony content not being uncommon. 99/

b. Estimates of Coking Coal Consumed in Antimony Smelting.

On the basis of smelting practices at the Vasjova Smelter in Czechoslovakia, 100/ checked against standard practices in the US and elsewhere, 101/ about 2.2 tons of coal are required for smelting 1 ton of metallic antimony. This is based on an assumed antimony content of 20 percent in the blast furnace charge, a recovery of 85 percent, a coke percent charge of 5 percent in roasting and 15 percent in smelting, and a coke-to-coal conversion factor of 1.45, plus about 30 percent for refining and miscellaneous. The ratio of 2.2 tons of coal per ton of metal is used for Communist China as well as for the USSR, Czechoslovakia, and East Germany, disregarding the slightly higher smelter recovery which is attributed to Communist China. Thus it is estimated that in 1953 a production of 5,000 tons of antimony metal in the USSR required the treatment of 280,000 tons of ore.

c. Estimates of Electric Power Consumption.

Consumption of electric power in the mining of antimony in the Soviet Bloc probably varies greatly according to method of mining, amount of water to be pumped from the mine, characteristics of the deposits, and many other factors. Because there is no information on the subject, a rough estimate of 25 kilowatt-hours per ton of ore mined is used as an average mining requirement throughout the Soviet Bloc.

In milling, one US mining company has a power requirement of 28 kilowatt-hours per ton for mills treating 150 short tons per day by flotation, 102/ but 25 kilowatt-hours is a more common figure for larger mills in the US. Because it is believed that concentrating mills in the Soviet Bloc are generally small, especially when weighted heavily by the numerous small Chinese operations, an estimate of 30 kilowatt-hours per ton of ore is used for power requirements in milling throughout the Bloc.

Electric power inputs in the smelting of antimony are not published even in the US. Power inputs in lead smelting, similar to antimony smelting, however, are available. In 1947, 141 million kilowatt-hours 103/ were used in smelting and refining 401,000 tons (441,000 short tons) of lead. 104/ In the absence of better information, electric power inputs in the refining of lead in the US in 1947 are used as the estimate for electric power inputs required for antimony smelting in the Soviet Bloc during 1948-53.

Combining the power requirements for mining, milling, and smelting on a per-ton-of-ore basis, a total of about 3,600 kilowatt-hours are required to produce a ton of metal. This figure is used to estimate power requirements in the Soviet Bloc. On this basis, production of 11,000 tons of antimony in Communist China in 1953 required approximately 40,000,000 kilowatt-hours of electric power.

d. Estimates of Labor Requirements.

Labor requirements for production of antimony in the USSR, Czechoslovakia, and Communist China are based on the labor-output ratio for the antimony operation at Oberboehmsdorf, East Germany, adjusted on the basis of size of operations involved in the other countries and other pertinent factors. At Oberboehmsdorf, 140 laborers were required to produce 109 tons of antimony in 1951, 105/ and 200 were required to produce 153 tons in 1952. 106/ This amounts to 0.75 tons of metal per worker per year. Because the mining and smelting operation in East Germany is very small, 0.75 tons per man is probably too low for the USSR and Czechoslovakia where economies of scale, especially in milling and concentrating, have become operative. Probably a closer ratio for those two countries, as an over-all average, is 0.95 tons of metal per worker.

Metal production per worker in Communist China is considered to be significantly lower than in East Germany. Although some mines and smelters are large, much of the mining, even in Hunan Province, is extremely primitive, with ore being carried by hand from mines to mills, and even between mills and smelters. 107/ Because of such primitive mining methods, it is unlikely that the output of metal in China exceeds about 0.4 tons per worker per year. A report that 2,000 laborers were employed in 1951 at the Wuchi mine, where production was planned to be 700 tons, supports the 0.4 figure. 108/ Using this ton-man ratio, the production of 11,000 tons of antimony in 1953 required a labor force of around 27,500.

e. Estimates of Fresh Water Requirements.

The amount of water required for the concentration of antimony ore in the Soviet Bloc is based on an estimate made for Communist China for the year 1948. 109/ This figure, 10 tons of fresh water per ton of ore, is applied to the estimates of the amounts of ore treated in each country of the Bloc. On this basis, the treatment of 377,000 tons of ore in Communist China in 1953 required around 3,300,000 tons of water.

APPENDIX C

## GAPS IN INTELLIGENCE

A minor metal such as antimony, understandably, is the subject of less information and less frequent reports than better known materials produced, consumed, and traded by the Soviet Bloc in greater quantities. The major deficiencies in information are as follows.

1. Production.

The most troublesome gap in intelligence that must be filled with regard to production is in data on country aggregates. Except for East Germany -- where there is only one antimony operation -- not a single figure representing an aggregate has been found since 1948 for any period of time for any country of the Soviet Bloc. Not even a percentage change over a previous period of time has been found.

2. Trade.

Information on shipments between the countries of the Soviet Bloc is fragmentary. More information is needed to check estimates which have been made. Antimony, be it metal or content in ores or concentrates, is a homogeneous commodity and is not plagued by "unit" difficulties as are items with variations in size and quality. More accurate measurement of the volume of trade should be possible.

3. Consumption.

Reports of quantities of antimony consumed in pertinent categories are, of course, not available. Although consumption in broad categories can be estimated with a fair degree of accuracy, an occasional actual figure for a category of consumption would be an invaluable benchmark which would increase the accuracy of estimates on consumption by other categories and of annual aggregates.

4. Inputs.

Except for East Germany, information on employment is very scanty. Employment by individual mines and smelters is needed to sharpen these estimates. Reports on other input factors are almost totally lacking, and estimates of such factors must therefore be based on indirect methods.

5. General.

a. Information on production, consumption, and trade is poorer and more fragmentary for Communist China than for any other country of the Soviet Bloc. Prior to 1948 the antimony mining industry had unusually good coverage. Since 1948 there is little but silence on antimony mining in China.

b. The development and present state of recovery of secondary antimony is an area on which there is little information. Knowledge of the amounts of secondary metal recovered and available to the Soviet Bloc would permit a more precise measurement of requirements for the primary metal.

APPENDIX D

SOURCES AND EVALUATION OF SOURCES

1. Evaluation of Sources.

a. USSR.

Much of the information on mines and smelters of the USSR, their size, location, and facilities, is from Army SDS's. These reports have the limitation of being 10 or 12 years old, but are considered generally reliable. There are virtually no current intelligence reports to bring the SDS information up to date with any high degree of certainty.

b. Czechoslovakia.

Much of the critical information on antimony mining in Czechoslovakia is available from open sources, written by Western observers who inspected these facilities as late as 1948. These sources are considered completely reliable. The Military Attache system and G-2 have furnished occasional reports which are considered reliable and bring earlier information up to date.

c. East Germany.

Intelligence reports on East Germany are the types of reports desired for other countries of the Soviet Bloc. The information, mostly in CS's and SO's, is specific and reliable, in contrast to the fragments coming out of the other countries.

d. Communist China.

Fortunately, information on antimony mining through 1948 in Communist China is very good, as a result of several surveys by US field teams. This fairly recent on-the-spot information offsets somewhat the paucity of information on current mining and smelting operations.

2. Sources.

Evaluations, following the classification entry and designated "Eval.," have the following significance:

| Source of Information | Information |
|---|---|
| Doc. - Documentary | 1 - Confirmed by other sources |
| A - Completely reliable | 2 - Probably true |
| B - Usually reliable | 3 - Possibly true |
| C - Fairly reliable | 4 - Doubtful |
| D - Not usually reliable | 5 - Probably false |
| E - Not reliable | 6 - Cannot be judged |
| F - Cannot be judged | |

"Documentary" refers to original documents of foreign governments and organizations; copies or translations of such documents by a staff officer; or information extracted from such documents by a staff officer, all of which may carry the field evaluation "Documentary."

Evaluations not otherwise designated are those appearing on the cited document; those designated "RR" are by the author of this report. No "RR" evaluation is given when the author agrees with the evaluation on the cited document.

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